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Fashion Prototypes Made from Environmentally Friendly Leather Substitute (Eco-Leather)

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Leather and pleather (plastic leather, mainly polyurethane and polyvinyl chloride PVC) are widely used materials in apparel, footwear, and accessories. Among the 2.2 billion pairs of footwear purchased by U.S. consumers in 2008, about one third (34%) were categorized as leather products and one third (34%) as plastic/vinyl products (AAFA, 2009). However, the production and use of leather (e.g., chromium used in leather tanning) and pleather (e.g., plasticizer phthalates used in PVC) cause major environmental and human health problems. To provide apparel and footwear industry with environmentally friendly materials, new breathable composites, eco-leather, were developed from natural fiber textiles and renewable, plant-based fatty acids. Earlier version of eco-leather was used in footwear development and the evaluation tests found that eco-leather materials with different mechanical properties, color, and footwear with different styles were the areas for improvement (Cao et al., 2014a). Based on the findings, new eco-leather samples were developed using different fabric substrates and material development processes. The comfort performance tests of new eco-leather samples found that eco-leather materials would be more comfortable for warm weather products such as summer shoes, or athletic products that require quick dissipation of body heat (Cao et al., 2014b).

Using the new eco-leather samples, a handbag and a bracelet were developed as in Figure 1 (a) and (b). The researchers also designed shoes, and worked with an external consultant (custom shoe maker) to develop shoe prototypes as in Figure 1 (c) and (d).

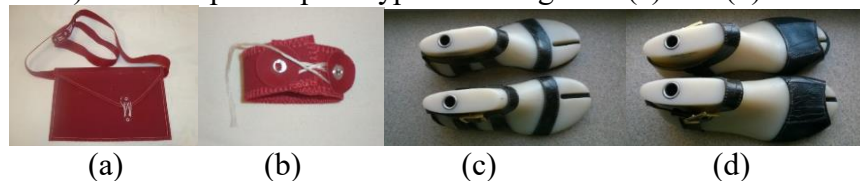


Figure 1. Accessories and footwear prototypes made from eco-leather materials

Human subject survey, focus group and wear tests were designed to evaluate the user's acceptance of eco-leather and fashion prototypes. The two shoe prototypes (shoe 1 as in Fig. 1(c) and shoe 2 as in Fig. 1(d)) were evaluated in all three tests, and the handbag and bracelet were also evaluated in the survey and focus group. All the participants were female students in a Mid-Atlantic university. Eight-four students completed the survey; 13 students participated in the focus group discussions, and 8 students participated in the wear test.

The survey participants were randomly separated into two groups. Half of the participants were educated about the sustainability features of eco-leather, and the other half participants did not have the "sustainability education" part. The survey used 7-point Likert scales with 7 as "extremely good". The survey results are in Table 1. The participants positively rated the quality,

feel/hand, and texture of the eco-leather, and overall appearance and comfort of the two shoe prototypes. The participants who were given the materials sustainability education gave higher ratings than those who were not, but the differences were not significant ($p>0.05$) for most of the questions. The wear test used 5-point Likert scales with 5 as “being the most/best” or “strongly agree”. The participants in the wear test thought eco-leather was suitable for shoe upper material (avg. ratings 3.75 for shoe 1 and 3.5 for shoe 2). Participants considered shoe 1 more “fashionable” (avg. rating = 3.875) than shoe 2 (avg. rating = 2.625). Though the two shoes were designed and developed for the same size (size 7), shoe 1 was easier to adjust for different feet, resulting in different ratings for fit (avg. rating 3.125 for shoe 1 and 1.625 for shoe 2), and the overall comfort rating (avg. rating 3.0 for shoe 1 and avg. rating 2.0 for shoe 2). Similar to survey and wear test, focus group results indicated shoe 1 design is better accepted by college students than shoe 2 design. One participant commented shoe 2 “is not for my age.” Most focus group participants also comments they liked the “eco-friendly” or “sustainability” characteristics of eco-leather and shoes. The survey and focus group results indicated the handbag and bracelet were less accepted than the shoes. However, quite a few participants indicated they liked the color of eco-leather used in handbag and bracelet.

Table 1. Survey results for eco-leather and prototypes (7-point Likert scale)

Question	with education		w/o education		t-test p-value
	Mean	σ	Mean	σ	
1. Rate the quality of eco-leather in handbag/bracelet	3.86	1.49	3.21	1.60	0.06
2. Rate overall appearance of handbag	3.21	1.42	2.90	1.59	0.35
3. Rate overall appearance of bracelet	3.40	1.68	3.07	1.55	0.35
4. Rate the quality of eco-leather in shoes	5.10	1.22	4.76	1.25	0.22
5. Rate feel/hand of eco-leather in shoes	5.29	1.27	4.93	1.30	0.20
6. Rate texture of eco-leather in shoes	5.29	1.17	5.00	1.21	0.27
7. Rate overall appearance of shoe 1 (Fig 1(c))	5.38	1.45	4.88	1.53	0.13
8. Rate the comfort level of shoe 1 (Fig 1(c))	5.10	1.23	4.49	1.17	0.03
9. Rate overall appearance of shoe 2 (Fig 1(d))	4.69	1.62	4.37	1.48	0.34
10. Rate the comfort level of shoe 2 (Fig 1(d))	4.86	1.38	4.49	1.23	0.22

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